8-7-2011

A Text-based Model for Identifying Online Trust Relationships

John Piorkowski
University of Maryland Baltimore County, Johnp2@umbc.edu

Lina Zhou
University of Maryland - Baltimore County, zhoul@umbc.edu

A Text-based Model for Identifying Online Trust Relationships

John Piorkowski
University of Maryland Baltimore County
Johnp2@umbc.edu

Lina Zhou
University of Maryland Baltimore County
Zhoul@umbc.edu

ABSTRACT

Trust has been a long-standing issue in online communities and is gaining importance with the popularity of online social networks. Traditional trust models theorize and explain trust, but they do not directly provide operationalization of trust relationships. In view that the text is the dominant medium of online communication, this paper develops a text-based model for identifying online trust relationships. Building on organizational trust models, social exchange theory, and speech-act theory, the proposed model conceptualizes trust relationship as a sequence of speech acts. The model is validated with the data collected from a real-world online community. This research not only creates a text-based method for identifying online trust but also lays the groundwork for automated analysis of online trust.

Keywords

Trust, online communities, discussion threads, speech act theory, social exchange.

INTRODUCTION

As social computing permeates our daily life, from pleasure to business, trustworthiness in social interactions becomes critical (Wang, Zeng, Carley, and Mao, 2007). An emerging area for online social networking includes financial investing. Social networking sites such as zecco.com, bogleheads.org, and covestor.com represent online communities that blend the social nature of a traditional investment club with the richness and breadth of a pure online social network [1]. However, the issue of trust rises with the popularity of these communities. For instance, the Whole Foods Market executive who anonymously posts fictional information regarding the finances of a competing company, Wild Oats Inc, to facilitate a corporate buyout[2].

Interpersonal trust has been studied extensively in organizational settings where face-to-face interaction is dominant as well as in virtual teams which primarily rely on computer-mediated communication. An online community is distinctively different from a virtual team because the latter consists of a group of individuals who are collectively working on a single task, whereas a community consists of a group of individuals who share common interests but may not be focused on a single task (Preece, 2004). Therefore, it is important to extend the trust research into online communities. Building on organizational trust models, conceptual models for online communities, social exchange theory, and speech-act theory, this research creates a text-based model for identifying trust relationships and conceptualizes trust relationship as a sequence of speech acts: directive, assertive, and commissive. The model is validated with the data collected from a real-world financial investing online community. This research not only creates a text-based method for identifying online trust but also lays the groundwork for automated analysis of online trust.

BACKGROUND

Two streams of trust research are reviewed in this section. First, the literature on organizational trust provides theoretical foundation for interpersonal trust. The second stream of research addresses trust among members who are working in virtual teams without prior face-to-face interaction.

[1] http://www.usnews.com/articles/business/your-money/2008/06/26/online-social-networks-for-stock-pickers.html

[2] http://articles.moneycentral.msn.com/Investing/Extra/WebScandalHitsWholeFoods.aspx

Organizational Trust Models

Trust models have been widely studied in organizational settings and they provide insights into the conditions necessary for trust relationships between two individuals.

McAllister (1995) postulated and validated a popular interpersonal organizational trust model that includes two forms of trust; affect-based and cognition-based trust. Affect-based trust is based on the emotional bonds between actors, as manifested in citizenship behavior and interaction frequency. Cognition-based trust stems from an individual making rational decisions on whether to trust another individual, which is attributable to reliable performance, cultural-ethnic similarity, and professional credentials. McAllister (1995) provided evidence for the antecedents of affect-based trust, but no evidence was found to support the asserted antecedents to cognition-based trust.

McKnight, Cummings, and Cherany (1998) built a trust model to explain initial trust formation between organizational parties. Historically, trust models claimed that initial trust would be low and gradually built over time. However, empirical studies (Kramer, 1996) of trust relationships showed that high trust can initially exist between parties. To address the "paradox of high initial trust levels", McKnight et al (1998) postulated a model for the establishment of initial trust by building on the following five streams of trust research:

- knowledge-based
- calculative-based
- personality-based
- institution-based
- cognition-based

Knowledge-based trust (KBT) forms over time based on an individual gaining relevant knowledge from a trusting individual. Calculative-based trust involves trusting an individual based on perceived risk and reward. Personality-based trust stems from an individual's childhood development and depending on the benevolence of the caregivers then the individual is more pre-disposed to be trusting. Institution-based trust reflects the security one feels about a situation because of guarantees, safety nets, or other structures. Cognition-based trust is based on initial impressions of the trustee versus personal interaction. However, there is only limited effort involved in this study to empirically validate the model.

The Lewicki and Bunker's framework (1996) includes three dimensions of trust; calculus-based trust (CBT), KBT, and identification-based trust (IBT). CBT recognizes the rewards for keeping trust and the punishment for violating trust and is similar to calculative trust identified by McKnight et al. (1998). Dependency and reliability provide the foundation for KBT. IBT centers on the identification of common goals. The three dimensions of this framework have been empirically validated in a recent study (McAllister, Lewicki, and Chaturvedi, 2006).

In addition Lewicki and Bunker (1996) described the evolution of trust with the initial stage of trust being CBT, followed by KBT, and finally IBT. The phases of trust evolution are illustrated in Figure 1.

Figure 1. Evolution of Trust (Lewicki and Bunker 1996)

Emphasis is placed on the first two phases of trust in this research because we are interested in trust identification in online communities where participants engage without previously established relationships. With no preexisting relationship in the community, new participants must experience CBT and KBT to form a trust relationship.

Calculus-Based Trust

CBT serves as the first phase of trust which is centered on the concept of risk versus reward. CBT involves risk between the trustee and trustor in the context of an exchange. Rousseau, Sitkin, Burt and Camerer (1998) point out that CBT is based on rational choice and trust emerges when the trustor perceives that the trustee intends to perform an action that is beneficial. Lewicki and Bunker (1996) derive their CBT model from the deterrence based trust model of Shapiro, Sheppard, and Cheraskin (1992). However, Lewicki and Bunker (1996) claim that CBT is not only motivated by the fear of violating trust

but also the benefit of building trust. They agree with Shaprio et al (1992) in that the deterrence aspect CBT will still dominate over the benefit seeking element of trust.

Knowledge-Based Trust

The key element of KBT includes the exchange of information that leads to a trustor viewing the trustee as being reliable and predictable. Lewicki and Bunker (1996) point out that the predictability is built through regular communications and the sharing of information. Another element of KBT includes courtship where an actor will observe another in a social setting.

McKnight, Choudhury, and Kacmar (2002) examined quantitative psychometric measures for trust in E-commerce. They introduced 16 cross-disciplinary sub-constructs to measure trust. Although they created trust measures additional research is required to derive direct measures for trust. The work provides a foundation for additional work in trust measures.

Trust in Virtual Teams

Jarvenpaa and Leidner (1999) examined the topic of trust and communications in global virtual teams with a large-scaled multi-nation empirical study. The notion of "swift trust" was observed as well as communications that would facilitate trust in global virtual teams. The finding of the research refutes the view that trust could not be formed in a virtual team (Handy, 1995).

Copella, Hiltz, and Rotter (2001) performed an empirical study to examine the concept of swift trust in an educational environment. They identified appropriate antecedents to reinforce swift trust. Iacono and Weisband (1997) performed an empirical study to explore swift trust by distinguishing between high and low performance teams in terms of level of interaction to measure trust levels and abilities to complete tasks. Their finding confirmed that of Copella et al (2001) and Jarvenpaa and Leidner (2001).

This stream of research demonstrated that trust can be established within virtual teams. The empirical work focused on teams that were brought together to address a particular task or activity. Applying organizational trust models and expanding the work on virtual teams to online communities leads to the development of the trust model described in the next section.

A TEXT-BASED TRUST MODEL FOR ONLINE COMMUNITIES

To motivate the trust model it is critical to understand the salient features of online communities and their role in trust as well as the role of social exchange and speech act theories in the context of trust.

Online Communities

An online community consists of the people who interact socially to satisfy their own needs or perform special roles with shared purpose whose interaction is guided by tacit and explicit policies using computer systems to support and mediate the social interaction (Preece, 2004). Preece points outs that successful online communities are based on cooperation and trust.

Other aspects of successful online communities include (Preece, 2004 and Whittiaker, Isaacs, and O'Day, 1997):

- A shared purpose
- Policies and norms
- Repeated interactions among participants
- Shared context and language

Based on these concepts, McArthur and Bruza (2001) established a model for online communities that include the components of purpose, commitment, context, and infrastructure. Their model is illustrated in Figure 2.

Shneiderman (2000) provides guidelines for designing trust into online communities. Shneiderman's principles include setting a context, providing a level of commitment, and providing a degree of quality and reliability. It is noted that these principles and the online community model such as the notion of commitment, quality and reliability can be directly tied to CBT and KBT of organizational trust models.

Discussion forum is a common media that supports the communication between members of contemporary online communities (Kim and Johnson, 2006). A thread in the online forum is created by a user who submits the first post. After the thread is created, users can comment on the thread by replying to any post in the thread. These interactions between community members in terms of text message exchange are leveraged in deriving trust relationships in the current research.

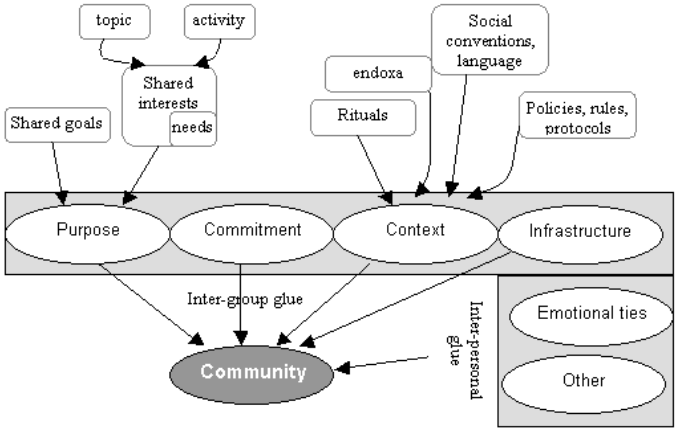

Figure 2 Online Community Model (McArthur and Bruza, 2001)

Social Exchange Theory

Blau (1964) describes social exchanges as reciprocal acts of benefit, in which individuals offer help, advice, approval, and so forth to one another without negotiation of terms and without knowledge of whether or when the other will reciprocate. The basic form of social exchange includes the direct interaction between two actors. Blau (1964) distinguishes between two forms of exchange; negotiated and reciprocal. In negotiated exchanges actors work towards a joint agreement that includes some form of binding agreement. For reciprocal exchanges actors' contributions to the exchange are asynchronously performed and develop over time. In this case actors initiate exchanges individually without knowing when and how the other actor will reciprocate in the future.

Molm, Takahash, and Peterson (2000) investigated reciprocal exchanges in terms of trustworthiness of the actor using a social exchange model. Behavior commitment served as a measure of trustworthiness. Their survey study shows that trust increases as the level of behavioral commitment increases (Molm et al, 2000).

Speech Act Theory

One approach for moving beyond survey instruments for trust measurement includes monitoring social exchanges in online communities and discovering certain speech acts.

Strawson (1964) provides the theoretical basis for speech acts and describes illocutionary acts that indicate commitment through speech. An illocutionary act is defined as "a basic unit of meaningful human interaction (Strawson, 1964)". When the illocutionary act conveys an intention to the hearer, an implied commitment has been made.

Searle (1975) classified speech acts into the following foundational types:

- Assertives: Commit the speaker to something being the case.
- Directives: Attempt to get the hearer to do something.
- Commissives: Commit the speaker to some future course of action.
- Expressives: Express a psychological state of affairs such as apologizing or praising.
- Declaration: Bring about correspondence between the prepositional content of the speech act and reality.

Kumar and Fernandez (2007) examine the concept of speech acts and its application to trust building in a virtual environment. Their framework is grounded on Winegrad and Flores's work on speech acts (1986), which models an interaction as a conversation where exchange parties go through cycles of request; negotiation, promises, and commitment; statement of performance; and acceptance.

The Trust Model

With the established research in organizational trust models and the fact that trust can be formed in virtual environments, this model extends trust research to an online community where members interact with one another through message exchanges. Based on social exchange theory and principles of designing trust into online communities, the model considers reciprocal exchanges and posits that behavioral commitment leads to increased trustworthiness. Moreover, in view that speech acts

serve as a foundation in information technology support for trust (Winegrad and Flores, 1986 and Kumar and Fernandez, 2007), this model analyzes speech acts in text to derive trust relationships.

A trust model is proposed in this research to identify trust relationships in a web-based online community that uses an internet forum as a primary means of participant communications. Alternative communications mechanisms for online communities can include chat rooms or news groups. Internet forums are organized in a hierarchy of discussion forums. The forums are organized as particular topics with individual discussion threads primary communications tool among participants. Therefore, the forum topic and the initial post in the discussion thread can provide indications of trust formation within the online community. Actors in an online community interact socially to satisfy their own needs (Preece, 2004). In addition, needs serve as a precursor to purpose which serves as key component of McArthur and Bruza's (2001) community model, where purpose can be manifested in online communities with various artifacts such as charters described in FAQs or specific forum topics. With this precept, a speech act is required to provide a social exchange that indicates an actor trying to meet their needs. The initial speech act addresses the first phase of trust that is CBT based on a risk versus reward. Among the five types of speech acts (Searle, 1975), directives serve the purpose of attempting the hearer to do something. In the context of an online community hearers are represented by participants reviewing discussion threads in the online community. The directive speech act suggests the initial action by a potential trustee to engage into a conversation. This is also consistent with the Winograd and Flores's (1986) action model that starts with a request.

The directive speech act provides an opportunity for other actors to engage into the conversation. Since our focus is on trust formation, according to the three-phase process model of Lewicki and Bunker (1996), salient factors of CBT and KBT influence the second speech act. Rousseau et al (1998) state that CBT emerges when the trustor perceives that the trustee intends to perform an action that is beneficial. For KBT, McKnight et al (1998) state that trust develops through experience with the other person when the trustee accumulates relevant knowledge. Therefore, a speech act, following the directive speech act, should involve the trustor providing knowledge (KBT) as well as an opportunity for an action that is beneficial to the trustee (CBT). This speech act falls into the category of an assertive speech act that commits potential trustees to something being true. Properties of assertive speech acts include statements of fact towards influencing the recipient to form a belief (Strawson, 1964).

The first two speech acts set the stage for a trust relationship and at least one more speech act is required to complete the trust relationship. McKnight et al (1998) developed an integrative trust model that includes institution-based trust as well as trusting intentions, trusting beliefs, and disposition to trust. An advantage of this model is that it provides measurement for each of the constructs. Among others, trusting intention refers to that the trustor is willing to depend, or intends to depend, on the trustee, which is further measured by four sub-constructs; willingness to depend on the trustee, providing personal information, buying from the vendor, and following vendor advice. They found that the construct for following vendor advice serves as a significant indicator of trusting intentions. Extrapolating the finding from the E-Commerce environment to interpersonal communication, the third component of our trust model is commissive speech act indicating that the trustor follows advice and commits himself to some future course of action.

In summary, the trust model contains the sequence of a directive, assertive, and commissive speech acts, as illustrated in Figure 3. The directive speech act is based on a "request for advice" by one member. The assertive speech act refers to a "commitment to the request" by another member who will respond to the initial request for advice by providing some form of advice. The commissive speech act indicates an "acceptance of advice" by the actor who originally requested the advice.

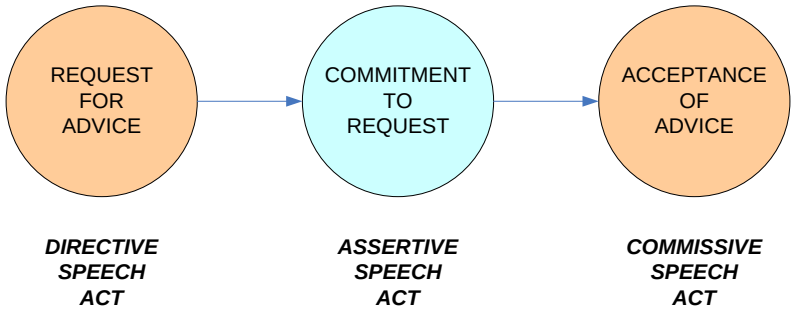

Figure 3 A Text-based Trust Model

RESEARCH DESIGN

An empirical study was undertaken to determine whether the proposed trust model can be used to identify trust relationships in an online community. A financial investing community was selected and analyzed to validate the trust model.

Data Collection

To explore trust relationships with a focus on KBT and CBT, an online community (bogleheads.org) was selected that involves both a high-risk environment and knowledge exchange among participating members. In bogleheads.org, community members manage their own financial portfolios with the help of peers instead of professional advisors, which leads to a higher degree of knowledge contribution in the community. For CBT, participants in this community take high risk since advice that they act on will impact their personal finances. In discussions with the administrator of the online community, he conveyed the risk adverse culture and general skepticism of other community members.

The data collection was extracted from the discussion forum "Help with Personal Investment". This forum addresses requests of individuals who are seeking advice on their personal finances. A list of over 30,000 discussion threads was crawled from the forum spanning the time period from February 2007 to January 2009. During the crawling process, the forum and topic names were extracted and stored in a database. Then, forum names were filtered to select only discussion threads that are related to "Help with Personal Investing". The remaining threads were further filtered via the search of keywords such as *help, advice, should, what, guidance, portfolio, and question*. These keywords were selected based on our understanding of forum posts that are likely to involve trust relationships. The final dataset contains 3761 threads.

Content Analysis

The content of all the selected threads was manually analyzed by a human coder to identify the sequence of speech acts. Sample cue phrases for each of the speech acts are listed in Table 1.

To cross validate the result of manual analysis, a second coder was employed to analyze a randomly selected subset of the dataset (400 threads) independently. Detailed instruction was provided to the coders, who were also given the opportunity of practicing with sample threads.

Results

The first coder discovered 333 threads that exemplify the trust model. The inter-rater reliability on the subset of 400 threads was measured with Kappa statistic (coefficient=0.64), indicating acceptable level of agreement between the two coders.

A subset of threads that received inconsistent results from the two coders was analyzed in detail. The results show that the threads conforming to the trust model identified by the second coder were a superset of the threads identified by the first coder. Among the different results, there were three threads identified by the second coder that the first coder later agreed to. The remaining 42 threads that were only identified by the second coder were grouped into four categories, as shown in Table 2. These threads were not treated as cases of the trust model for the reasons stated in Table 2.

Table 1 Sample Cue Phrases that Indicate Trust Relationships

Trust Model Construct	Speech Act Type	Sample Cue Phrases
Request for advice	Directive	"Any suggestions" "What is the best option for" "Would greatly appreciate any feedback or suggest on"
Commitment to request	Assertive	"You should probably put it" "Get rid of the" "Consider moving your"
Acceptance of advice	Commissive	"I think I will look into the ETF shares of these funds" "I will be putting new investments into" "I decided to go with"

Table 2 Grouping of Coding Differences

Category	Description	# Threads
General advice	Threads where the trustor seeks and acts on advice related to reading a book, using a tool, or going to a web site. Since no action is taken by the trustor that involves finances, these ties were discounted.	10
Weak commitment to advice	Thread involves the trustor acknowledging the advice given and indicates some form of action. However the action identified as the commissive speech act is vague.	22
Advice consistent with trustor's original actions	Thread involves the trustor receiving advice that was consistent with the trustor's current investment plans.	5
Actor only committed to study or consideration	Thread involves the trustor acknowledging the advice given and but only indicating additional study or consideration as a form of action.	5

DISCUSSION

Trust in organizational settings has been studied extensively and has led to trust models that are multi-faceted. The organizational settings rely on face-to-face interaction among participants. This research extends the organizational trust models to online community. We construct a text-based model of online trust that combines theoretical trust models with social exchange theory and speech-act theory. The model was tested through content analysis with results providing support for the trust model in an online community.

This work addresses a limitation in the prior literature where trust would be measured using psychometric surveys after interactions occurred. One issue with surveys is that some actors in online communities interact for only a brief period of time. Marin, Martinez, and Barrero (2009) identify these users as peripheral developers who contribute irregularly to online communities. Survey techniques are generally administered at a single point in time and there is difficulty in obtaining responses from irregular participants.

The text-based trust model for online communities provides opportunities for designing and developing new measurements of trust. A Forrester Group survey in 2008[3] indicated that only 21% of readers of message boards trust them. With better tools and techniques for measurement of trust, online communities can become more efficient and successful. The data collection revealed discussion threads that followed the trust model. However, after review of ~ 3,000 threads only 10% indicated trust relationships. Additional threads were recommended by the second coder but were not included in the data set given weaker commitment by the trustors. This result should be further explored to determine whether threads with trust relationships are a small subset of the overall discussion forum or whether the trust model is too restrictive. One argument for the former is the nature of this online community where participants are generally skeptical of advice. An argument for the latter is that more threads would be included as indicating trust relationships if the requirement for trustee commitment is relaxed.

Future research should focus on empirical validation of the trust model to refine the content analysis for commitment. This research would address the trust relationships that were discovered by the second coder and not included in the dataset.

Finally consideration should be given to applying the trust model to other online communities.

[3] http://forrester.typepad.com/groundswell/2008/12/people-dont-tru.html

CONCLUSION

This paper develops a text-based trust model for online communities building on strong theoretical foundation. The model provides a mechanism to identify interpersonal trust relationships in the context of online communities and lays the groundwork for measuring trust relationships based on actual text interaction and for developing tools that can automatically deriving trust relationships.

REFERENCES

1. Blau, P. (1964). *Exchange and Power in Social Life.* New York: Wiley.
2. Coppella, N., Hiltz, S., & Rotter, N. (2001, June). Building Trust in Virtual Teams. *IEEE Transactions on Professional Communication, 47*(2), 95 - 104.
3. Handy. (1995, May-June). Trust and the Virtual Organization. *Harvard Business Review.*
4. Iacono, C. S., & Weisband, S. (1997). Developing trust in virtual teams. *Proceedings of the Hawaii International Conference on Systems Sciences*.
5. Jarvenpaa, S., & Leidner, D. (1999, November- December). Communication and Trust in Global Virtual Teams. *Organization Science, 10*(6).
6. Jarvenpaa, S., Shaw, T., & Staples, D. (2004, September). Toward Contextual Theories of Trust: The Role of Trust in Global Virtual Teams. *Information Systems Research, 15*(3), 250-267.
7. Kim, B., & Johnson, P. (2006). Graphical Interface for Visual Exploration of Online Discussion Forums. *Journal of Systemics, Cybernetics and Informatics, 4*(4), 43-47.
8. Kramer, R. M., Brewer, M. B., & Hanna, B. A. (n.d.). Collective Trust and Collective Action: The Decision to Trust as a Social Decision. In *Trust in organizations: Frontiers of theory and research* (pp. 357-389). Thousand Oaks, CA: Sage.
9. Kumar, K., & Fernandez, I. (2007, March). Interaction technology: Speech act based information technology support for building collaborative relationships and trust. *Decision Support Systems, 43*(2).
10. Lewicki, R., & Bunker, B. (1996). Developing and maintaining trust in work relationships. In Kramer, *Trust in organizations; Frontiers of Theory and Research* (pp. 114-139). Thousand Oaks, CA: Sage Publications.
11. Marín, S. L., Martínez-Torres, M. R., & Barrero, F. &. (2009). An empirical study of the driving forces behind online communities. *Internet Research*(19), 378-392.
12. McAllister, D. (1995). Affect- and Cognition-Based Trust as Foundations for Interpersonal Cooperation in Organizations. *Academy of Management Journal , 3*(1), 24-59.
13. McAllister, D., Lewicki, R., & Chaturvedi, S. (2006). Trust In Developing Relationships: From Theory To Measurement. *Proceedings of the Academy of Management Meetings, 23.* Atlanta.
14. McArthur, R., & Bruza, P. (2001). The ABC's of Online Community. In Y. Y. Ning Zhong (Ed.), *Proceedings of the First Asia-Pacific Conference on Web Intelligence: Research and Development (WI '01.* London: Springer-Verlag.
15. McKnight D, Cummings , L., & Cherany , N. (1998). Initial Trust Formation in New Organizational Relationships. *Academy of Management Review, 23*(3), 473-490.
16. McKnight, D., Choudhury, V., & Kacmar, C. (2002). Developing and Validating Trust Measures for E-Commerce: An Integrative Typology. *INFORMATION SYSTEMS RESEARCH, 13*(3).
17. Molm, L., Takahash, N., & Peterson, G. (2000, March). Risk and Trust in Social Exchange: An Experimental Test of a Classical Proposition. *The American Journal of Sociology, 105*(5), 1396-1427.
18. Preece. (2004). *Online Communities: Designing Usability, Supporting Sociability.*
19. Rousseau, D., Sitkin, S., Burt, R., & Camerer, C. (1998). Not so Difference After All: A Cross Discipline View of Trust. *Academy of Management Review, 23*(3), 393-404.
20. Searle, J. (1975). A taxonomy of illocutionary acts. In K. Gunderson, *Language, Mind, and Knowledge* (pp. 344-369). University of Minnesota.
21. Shapiro, D., Sheppard, B., & Charaskin, L. (1992, October 8). Business on a Handshake. *Negotiation Journal*, 365-377.
22. Shneiderman, B. (2000). Designing trust into online experiences. *Communications of the ACM, 43*(12), pp. 57-59.
23. Strawson, P. (1964, October). Intention and Convention in Speech Acts. *The Philosophical Review, 73*(4), 439-460.
24. Wang F, Zeng D., Carley M. K, And Mao W., (March/April 2007), Social Computing: From Social Informatics to Social Intelligence, IEEE Intelligent Systems,
25. Whittaker, S., Isaacs, E., & O'Day, V. (1997). Widening the Net:Workshop Report on the Theory and Practice of Physical and Network Communities. *SIGCHI Bulletin, 29*(3).
26. Winograd, T., & Flores, F. (1986). *Understanding Computation and Cognition: A New Foundation for Design.* Addison-Wesley.